A Survey On Various Architectures, Models And Methodologies For Identifying Brain Tumor

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Abstract

Digital image processing in computer science is using computer algorithms to perform digital image processing operations. Digital image processing has many advantages over analog image processing as a subcategory or field of digital signal processing. It allows the input data to be applied to a much wider range of algorithms.

Image processing in the medical field focuses on image capture for both diagnostic and therapeutic purposes, including the analysis, enhancement and display of images captured through X-ray, ultrasound, MRI, nuclear medicine and optical imaging technologies. Image processing and analysis can be used to determine the size, volume and vasculature of a tumor or organ; flow parameters of blood or other fluids; and microscopic changes that have yet to raise any otherwise noticeable problems.

A brain tumor is a mass or growth of your brain's abnormal cells. There are two main types of tumors: cancerous (malignant) tumors and benign tumors.[2] Cancerous tumors can be divided into principal tumors that begin in the brain and secondary tumors that have spread elsewhere, known as tumors of brain metastasis. All brain

tumor types can give rise to symptoms that vary depending on the part of the brain involved.

Using fuzzy logic, our proposed methodology for identifying the brain tumor is established as a fuzzy inference system. Because fuzzy logic deals with uncertainty, its application is adequate and more effective in this area. Fuzzy C-means clustering algorithm along with self-organizing neural MAP network along with threshold and structure and function for proper medical data identification. First, to calculate the portion where the brain tumor is present, then identify all the parameter related to it.

This methodology provides a more effective way of detecting the brain tumor and helps bring the importance of computing to the medical field that helps doctors find the tumor very easily and as quickly as possible.

I. INTRODUCTION

Most of the central nervous system is an anterior part of the brain. Brain tumor is an abnormal growth caused by uncontrolled cell reproduction. One of the factors determining how a brain tumor affects the functioning of an individual and what symptoms the tumor causes is the location of tumors in the brain[1]. It forms the Central Nervous System (CNS) together with the spinal cord.Segmentation and classification of biomedical images play an important role in many applications especially in medical imaging[2], forming an important step in enabling qualification in the field of medical research as well as clinical practices. Brain MRI tumor detection and classification are done by manual investigation but it is varied from person to person and also very time-consuming process. But many new methods have been proposed to segment and classify the tumor lesions automatically. In both the training and test phase the input MRI brain image[3] is preprocessed. Preprocessing is carried out to increase the image quality[4] for further processing. Noise removal is carried out as the first step of preprocessing.

In medical imaging, 3D division of pictures plays aimperativepart in stages which happensometime recentlyexecutingprotestacknowledgment. 3D picturedivisionmakes a difference in computerizeddetermination of brain infections and makes a difference in subjective and quantitative investigation of pictures such as measuring exactestimate and volume of identifiedportion. Preciseestimations in brain determination are verytroublesomesince of differing shapes, sizes and appearances of tumors. Tumors can developunexpectedly causing surrenders in neighboring tissues too, which gives a generallyunusual structure for sound tissues as well. A procedure of 3D division of a brain tumor by utilizingsegmentation[5] in conjunction with morphological operations.

A. Image Segmentation

Image Segmentation is ancritical and troublesomeassignment in low level picturehandling, pictureanalysis etc. A group of cells or tissues (mass) which are beneath uncontrolled division and cannot be ceased by ordinarypowers can be characterized as Tumor[6]. Presently a days more well-founded calculations are created for genuine time investigation and conclusion of tumor. The primarycenter in most recentimprovement in therapeutic imaging is to identify brain tumors in MR pictures and CT filterpictures[7]. The partition of the cells and their cores from the rest of the picture substance is one of the most issues confronted by most of the restorative symbolism conclusion frameworks. Analyze of the framework yield is fundamental centered on segmentation. This paper bargains with the concept for programmed brain tumor division. The foremosthighlights and objects of brain can be seendependablyutilizing MRI and CT checks. In this paper MRI checkedpicture is taken for the whole handle .

B. Tumor:

An abnormal mass of tissue. Tumors can be benign or malignant (cancerous). There are hundreds of different types of tumors[8]. Their names usually reflect the kind of tissue they arise in, and may also tell you something about their shape or how they grow. Diagnosis depends on the type and location of the tumor. Tumor marker tests and imaging may be used; some tumors can be seen (for example, tumors on the exterior of the skin) or felt (palpated with the hands). Treatment is also specific to the location and type of the tumor.

a). *Benign Tumors*:

A **benign tumor** is a mass of cells (tumor) that lacks the ability to invade neighboring tissue or metastasize. These do not spread into, or invade, nearby tissues; however, they can sometimes be quite large. When removed, benign tumors usually do not grow back.

b). Malignant tumor:

Malignant means that the tumor is made of cancer cells, and it can invade nearby tissues. Some cancer cells can move into the bloodstream or lymph nodes, where they can spread to other tissues within the body—this is called metastasis. Cancer can occur anywhere in the body including the breast, intestines, lungs, reproductive organs, blood, and skin.

C. Magnetic Resonance Imaging (MRI):

MRI is essentiallyutilizedwithin the biomedical to identify and visualize bettersubtle elementswithin theinside structure of the body. This technique is essentiallyutilized to distinguish the contrastswithin the tissues which have a distant better technique as compared to computed tomography[3]. So this makes this procedurean awfullyextraordinary one for the brain tumor discovery and cancer imaging. CT ionizing radiation but MRI employmentssolidattractive field to adjust the atomic magnetization at that point radio frequencies changes the alignment of the magnetization which can be identified by the scanner. That flag can be encouraging prepared to make the additional data of the body.

D. Techniques used in identifying brain tumor :

There are various techniques which have been developed till now in the medical technological field, various techniques proved to be a great advancement in the field of technology.

Partition of Brain Tissues in MRI based on Multidimensional FCM and Spatial Data This procedure was proposed by Jamal Ghasemi, Mohamad Reza Karamimollaei and Ali Hojatoleslam. A novel strategy for brain MRI division (BMS) based on multi-dimensional standard FCM has been proposed. Distinctivehighlights of neighboring pixels like cruel, solitaryesteem, and standard deviation in combination with pixel concentrated has been utilized for commonplace pixel division. The comes aboutassessment is done against manual division on a freelyaccessible dataset.

Fundamental components of structural brain MRI investigation[9]include the classification of MRI information into particular tissue sorts and the recognizable proof and depiction of particular anatomical structures. Classification implies to allot to each componentwithin thepicture a tissue course, where the classes are characterized in progress. The issues of segmentation and classification are interlinked sincedivisioninfers a classification, whereas a classifier verifiablyfragmentsanpicture

Author	Proposed technique	Procedure used	Inputs given	inference
Zhang	Segmentation	Expectation minimization	Image of a brain with spatial and statistical images	Requires thresholding and does not produce accurate results
Ahmed	Bias field estimation	Modified fuzzy C means	Images of a scanned brain under MRI	Faster to generate results but limited to a single feature input
Tolba	Gaussian multiresol	maximization	Brain scanned	These are less

	ution analysis		image with edges intact to image	sensitive to noise and rarely preserving the edges
Sing	Neural Network	Fuzzy adaptive network	Brain scanned image with all the possible information	It preserves the sharpness of the image
Yu	Fuzzy partition entropy of 2D	QGA	Brain image which is distributed according to the partition	This methodology is practically impossible
kumar	Automated segemtnation	Seeded region growing	An MRO image with possible abnormalities present in a brain	This methodology takes more time and moreover it detects the abnormalities present in the brain
Roy	Modular approach to solve MRI segmentation	Symmetry analysis	Brain image which is completely quantified	This procedure takes more time. This finds the status of the increasing condition of the disease in the brain.

E. Various techniques in finding the distance to find the brain tumor in image processing.

Sl no.	**Distance technique**	**formula**
1	Euclidean technique	$d(a,b) = \sqrt{(bx-ax)^2+(by-ay)^2}$
2	Chamfer technique	$d_M(A,B) = \min_{\rho_{AB}} W(\rho_{AB})$
3	Geo desic distance	$d(a,b) = \inf_{r \epsilon P_{a,b}} \int_0^{l(r)} \sqrt{1+\gamma^2 \left(\nabla I(s).r'(s)\right)^2}$
4	Manhattan distance	$MH(a,b) = \lvert x_1-y_1\rvert + \lvert x_2-y_2\rvert + \ldots + \lvert x_n-y_n\rvert$
5	City block distance	$d_{ij} = \min_{(x,y)\epsilon B}\{\lvert i-x\rvert + \lvert j-y\rvert\}, 0 \le i,j \le n-1.$
6	Chess board distance	$D_{Chess} = \max(\lvert x_2-1\rvert, \lvert y_2-y_1\rvert)$

a). EUCLIDEAN DISTANCE

The Euclidean distance[8] is the distance between two points in euclidean space. The two points P and Q in two dimensional euclidean spaces and P with the coordinates (p1, p2), Q with the coordinates (q1, q2). The line segment with the endpoints of P and Q will form the hypotenuse of a right angled triangle. The distance between two points p and q is defined as the square root of the sum of the squares of the differences between the corresponding coordinates of the points. The two-dimensional Euclidean geometry, the Euclidean distance between two points a = (ax, ay) and b = (bx, by) is defined

$$d(a,b) = \sqrt{(bx-ax)^2 + (by-ay)^2}$$

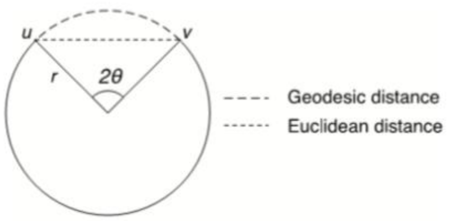
b). CHAMFER DISTANCE

The chamfer distance relatively well approximates the euclidean distance and is widely used because of its relatively small computational requirements as it imposes only 2 scans of the n-dimensional image independently of the dimension of the image. The chamfer distances are widely used in image analysis of the Euclidean distance with integers [Eric Remy et al., 2000]. The chamfer distance dM between 2 points A and B is the minimum of the associated costs to all the paths PAB A to B. Chamfer distance was first proposed an evaluation of two dimensional asymmetric distance between two set of edge points.

$$d_{\mathcal{M}}(A,B) = \min_{\mathcal{P}_{AB}} W(\mathcal{P}_{AB})$$

c). GEODESIC DISTANCE

Geodesics are locally shortest paths in the sense that any perturbation of a geodesic Curve will increase the length. The minimal length path between two points on the surface is the minimal geodesics connecting those points[10]. Geodesics minimize the Euclidean distance on a surface and a geodesic distance between two vertices of a triangle mesh surface, for instance is computed using a shortest path algorithm on the mesh graph, where the weight associated with an edge is its length.



d). MANHATTAN DISTANCE

The distance between two points in a grid is based on a strictly horizontal and/or vertical path as opposed to the diagonal. The Manhattan distance is the simple sum of the horizontal and vertical components, whereas the diagonal distance might be computed by applying the Pythagorean Theorem [Wikipedia, 2010]. It is also called the L1 distance[11] and of u = (x1 , y1) and v = (x2 , y2) are two points, then the Manhattan distance between u and v is given by

$$MH(u,v) = |x_1 - x_2| + |y_1 - y_2|$$

e). CITY BLOCK DISTANCE

The city block distance is always greater than or equal to zero. The measurement would be zero for identical points and high for points that show little similarity. The cityblock distance measuring horizontal and vertical directions and the chessboard distance takes diagonal directions. The chamfer distance is faster than the city-block distance and cityblock distance largely over estimates distances towards 45 directions. This makes the needed rectangular area around the moving object for the city-block distance than the chamfer distance [Theo E. Schouten et al., 2005].

$$d_{ij} = \min_{(x,y)\epsilon B} \{|i-x| + |j-y|\}, 0 \le i, j \le n-1.$$

The city block distance transform is a basic operation in computer vision, pattern recognition and robotics. For instance, if the black pixels represent obstacles, then dij tells us how far the point (i, j) is from these obstacles.

f). CHESS BOARD DISTANCE

The chessboard distance is a metric defined on a vector space where the distance between two vectors is the greatest of their differences along any coordinate dimension. In two dimensions, i.e. plane geometry, if the points P and Q have Cartesian coordinates (x1, y1) and (x2, y2), their chessboard distance is:

$$D_{Chess} = \max(|x_2 - x_1|, |y_2 - y_1|)$$

F. APPLICATION OF SEGMENTATION

Segmentation is a fundamental problem in image depiction and/or classification. Segmentation is the methodology of distinguishing an observed image into its constituent areas. Image segmentation is commonly used to find items and edges in the image[12]. The result of image segmentation largely covers the entire image, or an arrangement of bends took out from the image. Consequently, image segmentation is one of the early vision issues and has a wide application space

segmentation is used for detection and diagnosis of normal and pathological tissues such as MS tissue abnormalities and tumors. These abnormalities could be identified by tracking of changes in volume, shape and regional distribution of brain tissue during follow-up of patients[13]. Also, some of the neurological and psychiatric disorders such as Alzheimer's, Parkinson's and Huntington's disease, depression, autism, can be diagnosed with detection of changes in the morphology of subcortical nuclei and the cerebellum.

Furthermore, brain image segmentation plays an important role in clinical diagnostic tools and treatment procedures such as diagnosis and follow-up and also 3D brain visualization[14] for measuring the volume of different tissues in brain such as Gray and White Matter, Thalamus, Amygdala, Hippocampus etc. However, some authors try to change the problem to a three-type tissue classification and they assume multiple gray matter structures as one class. Hence, they label brain volumes into a three main classes like WM, GM, Cerebrospinal fluid (CSF) . Internet Brain Segmentation Repository (IBSR)[12] provided by the Center for Morphometric Analysis (CMA) at Massachusetts General Hospital and also, BrainWeb, which has been collected at McConnell Brain Imaging Centre of the Montreal Neurological Institute, McGill University are two well-known dataset for this area of research

1. Medical Imaging:

- Locate tumours
- Measure tissue volumes
- Computer-guided surgery
- Diagnostic Treatment planning
- Study of anatomical structure

MR Brain Image Segmentation

MRI brain images are broadly utilized as a part of Therapeutic Applications to inquire about, conclusion, treatment and image guided surgeries. The noise in MRI because of warm vibrations of electrons, particles may influence the execution of image processing systems utilized for brain image examination. Because of this sort of artefact and noises, at times one kind of ordinary tissue in MRI might be misclassified[14] as other kind of typical tissue and it prompts blunder amid determination. Therefore, it is important to have a segmentation in the consequent sections of ordinary tissues, for example, WM, GM and CSF from MR brain image with Rician noise and Intensity Inhomogeneity artefact.

Precise segmentation of Normal Tissues are used to measure the volume changes in these tissues for clinical conclusion to distinguish the illnesses because of the outline of tissues by the therapeutic professional.

Applications of MR brain image segmentation

- Radiotherapy planning
- Image-guided interventions
- Surgical planning by using EEG or FMRI information
- Brain disease studies

Manual segmentation makes the division irreproducible and breaking down. Henceforth, there is a genuine requirement for automated MRI segmentation instruments.

We present a compact review of the different methods, which are proposed in recent years for MRI brain segmentation. We try to divide these methods into two main important categories such as supervised (and semi-supervised) and unsupervised methods.

G. CONCLUSIONS

The main purpose of the work is to exploit brain tumor identification context using the most efficient and improved technique of fuzzy logic methods than other methods.Tumor can be found more accurately and with just a few seconds for execution, rapid detection is also achieved. By using the scanner, the brain's input image is taken either from the available database or from the real-time image. In order to detect the presence of tumor in the input image, 3D slicer can also analyze the tumor area.

We finally conclude a novice and an efficient method to find the brain tumor with the computing technology that has developed till date, which bridges the gap between medical field and the computing technology, this method helps to replace many standard outdated methods which proven to be risky, inefficient and non-accurate which might be difficult task.

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